

Previous Years Paper

7th June 2023 (Shift 3)

Q1. Match List - I with List - II.

	List - I		List - II
(A)	Tetracarbonylnickel(0)	(I)	$[\text{CoCl}_2(\text{en})_2]^+$
(B)	Tetraammineaquachloridocobalt(III) chloride	(II)	$\text{K}_2[\text{Zn}(\text{OH})_4]$
(C)	Potassium tetrahydroxidozincate(II)	(III)	$[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$
(D)	Dichloridobis(ethane-1,2-diamine)cobalt(III)	(IV)	$[\text{Ni}(\text{CO})_4]$

Choose the **correct** answer from the options given below:

(a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

(b) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(c) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

(d) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Q2. Match List - I with List - II.

	List - I		List - II
(A)	Cheese	(I)	Emulsions
(B)	Cell fluids	(II)	Aerosol
(C)	Hair cream	(III)	Gel
(D)	Clouds	(IV)	Sol

Choose the **correct** answer from the options given below:

(a) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

(b) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(c) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

(d) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

Q3. Match List - I with List - II.

	List - I		List - II
(A)	Cubic	(I)	$a = b \neq c$
(B)	Tetragonal	(II)	$a \neq b \neq c$
(C)	Orthorhombic	(III)	$a = b \neq c$
(D)	Hexagonal	(IV)	$a = b = c$

Choose the **correct** answer from the options given below:

(a) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

(b) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(c) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

(d) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)

Q4. Match List - I with List - II.

	List - I		List - II
(A)	Λ_m of KCl increases on dilution	(I)	is a linear graph
(B)	Λ_m of CH_3COOH increases on dilution	(II)	is a non-linear graph
(C)	Λ_m of KCl versus $(\text{molarity})^{\frac{1}{2}}$	(III)	Due to increased degree of ionisation
(D)	Λ_m of CH_3COOH versus $(\text{molarity})^{1/2}$	(IV)	Due to weakening of interionic attractions

Choose the **correct** answer from the options given below:

(a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

(b) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

(c) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

(d) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

Q5. Glucose on reaction with bromine water forms gluconic acid which confirms the presence of:

(a) $-\text{COOH}$ group

(b) $-\text{CHO}$ group

(c) Five $-\text{OH}$ groups

(d) Ketonic group

Q6. $\text{Ph}-\underset{\substack{| \\ \text{Cl} \\ (+)}}{\text{CH}}-\text{CH}_3 \xrightarrow[\Delta]{\text{alc.KCN}} ?$

Product formed is:

(a) $\text{Ph}-\underset{\substack{| \\ \text{CN} \\ (\pm)}}{\text{CH}}-\text{CH}_3$

(b) $\text{Ph}-\underset{\substack{| \\ \text{CN} \\ (-)}}{\text{CH}}-\text{CH}_3$

(c) $\text{Ph}-\text{CH}=\text{CH}_2$

(d) $\text{Ph}-\underset{\substack{| \\ \text{CN} \\ (+)}}{\text{CH}}-\text{CH}_3$

Q7. Which of the following hormone is also known as flight hormone?

(a) Adrenaline

(b) Androgens

(c) Thyroxine

(d) Insulin

Q8. An analysis of iron oxide shows that its formula is $\text{Fe}_{1.9}\text{O}_3$. What percentages of iron exists as Fe^{3+} and Fe^{4+} ions:

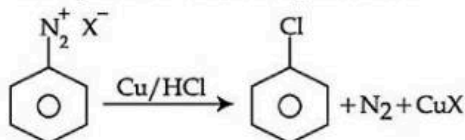
(a) $\text{Fe}^{3+} = 82.98\%$ and $\text{Fe}^{4+} = 17.02\%$

(b) $\text{Fe}^{3+} = 84.21\%$ and $\text{Fe}^{4+} = 15.79\%$

(c) $\text{Fe}^{3+} = 15.79\%$ and $\text{Fe}^{4+} = 84.21\%$

(d) $\text{Fe}^{3+} = 17.02\%$ and $\text{Fe}^{4+} = 82.98\%$

Q9. Identify the name reaction given below:



- (a) Gatterman Reaction
(b) Sandmeyer Reaction
(c) Gatterman – Koch Reaction
(d) Dow's Process

Q10. Match List – I with List – II.

List – I		List – II	
(A)	Williamson's Synthesis	(I)	$C_6H_5Cl + NaOH \xrightarrow[High\ pressure]{350^\circ C}$
(B)	Reimer Tiemann reaction	(II)	$C_6H_5OH + C_6H_5COCl \xrightarrow{aq\ NaOH}$
(C)	Dow's process	(III)	$CH_3CH_2ONa + CH_3Cl \xrightarrow{heat}$
(D)	Schotten Baumann reaction	(IV)	$C_6H_5OH + CHCl_3 + NaOH \xrightarrow{heat}$

Choose the **correct** answer from the options given below:

- (a) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
(b) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(c) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(d) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q11. Which of the following is the correct range of critical micelle concentrations (CMC) for soaps?

- (a) 10^2 to 10^4 mol/L
(b) 10^{-5} to 10^{-8} mol/L
(c) 10^{-1} to 10^{-3} mol/L
(d) 10^{-4} to 10^{-3} mol/L

Q12. Match List – I with List – II.

List – I		List – II	
(A)	Element with highest second ionization enthalpy	(I)	Co
(B)	Element with highest third ionization enthalpy	(II)	Cr
(C)	M in $M(CO)_6$ is	(III)	Cu
(D)	Element with highest heat of atomization	(IV)	Zn

Choose the **correct** answer from the options given below:

- (a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(b) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
(d) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Q13. Arrange the following compounds in decreasing order of acidity:

- (A) *o*-cresol
(B) Phenol
(C) *m*-nitrophenol
(D) *o*-nitrophenol
(E) Ethanol

Choose the **correct** answer from the options given below:

- (a) $D > B > C > E > A$
(b) $E > A > B > C > D$
(c) $C > D > A > B > E$
(d) $D > C > B > A > E$

Q14. The vapour pressure of pure Benzene is 0.900 bar. If a nonvolatile electrolytic solid is added, vapour pressure of the solution becomes 0.200 bar. If numbers of moles of solute is 1 and solvent is 2 respectively in solution, what is the value of van't Hoff factor (i)?

- (a) 2.33
(b) 0.56
(c) 1.56
(d) 2.00

Q15.

	Sol	Charge present	
(A)	Blood	-	Positive
(B)	Congo red	-	Positive
(C)	Gum	-	Negative
(D)	Gold sol	-	Positive
(E)	$Fe(OH)_3$ sol	-	negative

Choose the **correct** answer from the options given below:

- (a) (A) and (C) only
(b) (B) and (D) only
(c) (C) and (E) only
(d) (B) and (E) only

Q16. Out of the following which will not undergo S_N1 reaction pathway:

- (a) 1-Chloro-1, 1, 1-triphenylmethane
(b) 2-Iodo-2-methylpropane
(c) 1-Bromo-3, 3-dimethylbutane
(d) 3-Bromoprop-1-ene

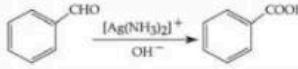
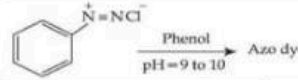
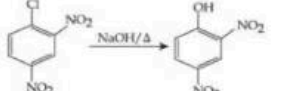
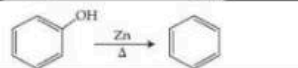
Q17. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition elements which shows highest magnetic moment:

- (a) $3d^7$
(b) $3d^5$
(c) $3d^8$
(d) $3d^2$

Q18. Identify incorrect statement about $H_2 - O_2$ fuel cell from the following:

- (a) At cathode O_2 is reduced to OH^-
(b) At anode H_2 is oxidized to form water
(c) The cell runs continuously even if reactants are not supplied
(d) Water is formed as a by product

Q19. Match List – I with List – II.

	List - I		List - II
(A)		(I)	Nucleophilic substitution Reaction
(B)		(II)	Elimination Reaction
(C)		(III)	Electrophilic substitution Reaction
(D)		(IV)	Redox Reaction

- (a) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
 (b) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
 (c) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
 (d) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

Q20. $A + B \rightarrow \text{Nylon 6, 6}$

Predict A and B:

- (a) Ethylene glycol + adipic acid
 (b) Pentamethylene diamine + adipic acid
 (c) Hexamethylene amine + tartaric acid
 (d) Hexamethylene diamine + adipic acid

Q21. Match List - I with List - II.

	List - I (Complex ion)		List - II (Hybridisation)
(A)	$[\text{CoF}_6]^{3-}$	(I)	d^2sp^3
(B)	$[\text{Co}(\text{CN})_4]^{2-}$	(II)	sp^3d^2
(C)	$[\text{FeCl}_4]^-$	(III)	sp^3
(D)	$[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$	(IV)	dsp^2

Choose the **correct** answer from the options given below:

- (a) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
 (b) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
 (c) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
 (d) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

Q22. Match List - I with List - II.

	List - I		List - II
(A)	Copper pyrites	(I)	Cu_2O
(B)	Malachite	(II)	Cu_2S
(C)	Cuprite	(III)	$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
(D)	Copper glance	(IV)	CuFeS_2

Choose the **correct** answer from the options given below:

- (a) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)
 (b) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
 (c) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
 (d) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

Q23. Which of the following has the highest flocculating power?

- (a) $[\text{Fe}(\text{CN})_6]^{4-}$
 (b) PO_4^{3-}
 (c) SO_4^{2-}
 (d) Cl^-

Q24. Match List - I with List - II.

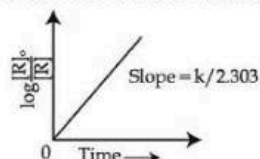
	List - I		List - II
(A)	$\text{PbS} \rightarrow \text{PbO}$	(I)	Roasting
(B)	$\text{CaCO}_3 \rightarrow \text{CaO}$	(II)	Calcination

(C)	$\text{ZnS} \rightarrow \text{Zn}$	(III)	Carbon reduction
(D)	$\text{Cu}_2\text{S} \rightarrow \text{Cu}$	(IV)	Self reduction

Choose the **correct** answer from the options given below:

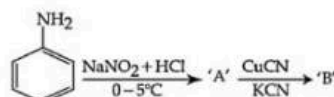
- (a) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
 (b) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
 (c) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (d) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

Q25. For the reaction, $R \rightarrow P$, the $\log ([R]_0/[R])$ verses time (t) plot is given below. What is the order of reaction and what are the units of rate constant?



- (a) Zero order, s^{-1}
 (b) First order, s^{-1}
 (c) Second order, $\text{mol}^{-1} \text{L s}^{-1}$
 (d) Zero order, $\text{mol L}^{-1} \text{s}^{-1}$

Q26.



The compound B is:

- (a) Acetanilide
 (b) Benzonitrile
 (c) Benzamide
 (d) Benzene

Q27. Which of the following is an example of negatively charged sol?

- (a) $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$
 (b) As_2S_3
 (c) TiO_2
 (d) Blood

Q28. Which of the following is an example of minimum boiling azeotrope?

- (a) Phenol and aniline
 (b) Chloroform and acetone
 (c) Nitric acid and water
 (d) Ethanol and acetone

Q29. The correct statement about 4f-series elements is:

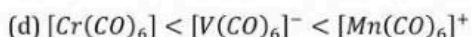
- (a) Paramagnetism falls to minimum in Nd.
 (b) Lu^{3+} ions are bright green in aqueous solution.
 (c) Promethium is artificially synthesised 4f series element.
 (d) Absorption bands of Lanthanoids are broad.

Q30. Which of the following reagents, are used for denaturation of alcohol?

- (a) CuSO_4 and pyridine
 (b) FeSO_4 and CHCl_3
 (c) FeCl_3 and pyridine
 (d) CuSO_4 and freon

Q31. The correct bond order for carbon-oxygen bond in following metal carbonyls

- $[\text{Cr}(\text{CO})_6]^-$, $[\text{V}(\text{CO})_6]^-$, $[\text{Mn}(\text{CO})_6]^+$ is
 (a) $[\text{V}(\text{CO})_6]^- < [\text{Cr}(\text{CO})_6]^- < [\text{Mn}(\text{CO})_6]^+$
 (b) $[\text{V}(\text{CO})_6]^- = [\text{Cr}(\text{CO})_6]^- = [\text{Mn}(\text{CO})_6]^+$
 (c) $[\text{Mn}(\text{CO})_6]^+ < [\text{Cr}(\text{CO})_6]^- < [\text{V}(\text{CO})_6]^-$



Q32. Which of the following is the correct formula of a colligative property?

- (a) $\frac{P_1^0 - P_1}{P_1^0} = x_1$
 (b) $\Delta T_b = \frac{K_b \times 1000 \times w_2}{M_1 \times w_1}$
 (c) $\Delta T_f = \frac{K_f \times 1000 \times w_2}{M_2 \times w_1}$
 (d) $\pi = \Delta T_f RT$

Q33. Which of the following reaction has fractional order with respect to one of the reactants?

- (a) $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
 (b) $CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$
 (c) $CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$
 (d) $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$

Q34. The amount of radioactive substance left after 75 hrs, when 100g of it is taken initially will be:
 (half-life of radioactive substance is 15 hrs)

- (a) 12.5 g
 (b) 6.25 g
 (c) 1.5625 g
 (d) 3.125 g

Q35. The cell $Zn|Zn^{2+} (1M)||Cu^{2+} (1M)|Cu$. ($E^\circ_{cell} = 1.10 V$)
 Was allowed to be completely discharged at 298 K.
 The relative concentration of Zn^{2+}/Cu^{2+} is:

- (a) 9.65×10^4
 (b) Antilog 24.8
 (c) 37.7
 (d) $10^{37.3}$

Q36. In which of the following cases there is a change in oxidation number?

- (a) Aqueous solution of CrO_4^{2-} is acidified
 (b) SO_2 gas is passed through acidified $Cr_2O_7^{2-}$ solution
 (c) $Cr_2O_7^{2-}$ solution is made alkaline
 (d) CrO_2Cl_2 is dissolved in NaOH

Q37. Match List - I with List - II.

	List - I		List - II
(A)	Adenine	(I)	Purine
(B)	Thymine	(II)	Pyrimidine
(C)	Uracil	(III)	DNA
(D)	Deoxyribose	(IV)	RNA

Choose the **correct** answer from the options given below:

- (a) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
 (b) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
 (c) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (d) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q38. Match List - I with List - II

	List - I (Drug)		List - II (Use)
(A)	Phenelzine	(I)	Antibiotic
(B)	Terfenadine	(II)	Antihistamine
(C)	Codeine	(III)	Antidepressant
(D)	Salvarsan	(IV)	Analgesics

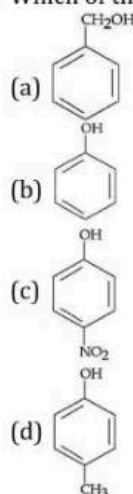
Choose the **correct** answer from the options given below:

- (a) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
 (b) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
 (c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
 (d) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

Q39. Which of the following alkyl halides will undergo S_N2 reaction most readily?

- (a) 1-Bromo-2,2-dimethylpropane
 (b) 1-Bromo-2-methylbutane
 (c) 1-Bromobutane
 (d) 1-Bromo-3-methylbutane

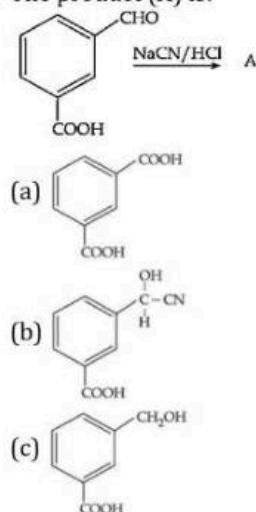
Q40. Which of the following compound is the most acidic?

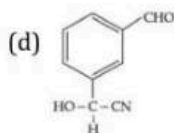


Directions (Q41 to Q45) Answer the question on basis of passage given below:

Organic compounds containing carbon-oxygen double bond ($C=O$) are called carbonyl compounds. These are highly polar molecules. Hence, their boiling points are higher than hydrocarbons and ethers. Aldehydes can be prepared from dehydrogenation or oxidation of alcohols and by reduction of acylhalides. Ketones are prepared by oxidation of secondary alcohols or by hydration of alkynes etc. Aldehydes and ketones undergo nucleophilic addition reaction with the number nucleophiles such as HCN, $NaHSO_3$, ammonia derivatives. Carboxylic acids are prepared by the oxidation of primary alcohols, aldehydes and alkenes, by hydrolysis of nitriles. Carboxylic acids are more acidic than alcohols and phenols.

Q41. The product (A) is:





Q42. The correct increasing order of acidic strength is:

- (a) $\text{C}_6\text{H}_5\text{COOH} < \text{C}_6\text{H}_5\text{CH}_2\text{COOH} < \text{NO}_2\text{CH}_2\text{COOH} < \text{FCH}_2\text{COOH}$
 (b) $\text{C}_6\text{H}_5\text{CH}_2\text{COOH} < \text{C}_6\text{H}_5\text{COOH} < \text{NO}_2\text{CH}_2\text{COOH} < \text{FCH}_2\text{COOH}$
 (c) $\text{C}_6\text{H}_5\text{CH}_2\text{COOH} < \text{C}_6\text{H}_5\text{COOH} < \text{FCH}_2\text{COOH} < \text{NO}_2\text{CH}_2\text{COOH}$
 (d) $\text{C}_6\text{H}_5\text{COOH} < \text{FCH}_2\text{COOH} < \text{C}_6\text{H}_5\text{CH}_2\text{COOH} < \text{NO}_2\text{CH}_2\text{COOH}$

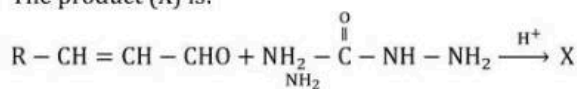
Q43. The correct sequence of reagents for the conversion of 3-nitrobromobenzene to 3-nitrobenzoic acid is:

- (a) $\text{Mg/ether, CO}_2, \text{H}_3\text{O}^+$
 (b) $\text{KCN, LiAlH}_4, \text{NaOH}$
 (c) $\text{KMnO}_4/\text{OH}^-, \text{dil. H}_2\text{SO}_4, \text{CO}_2/\text{H}^+$
 (d) AgNO_3 (Ammonical), $\text{CO}_2, \text{H}_3\text{O}^+$

Q44. Which of the following is most reactive towards nucleophilic addition reaction?

- (a) Butanone
 (b) Propanone
 (c) Ethanal
 (d) Propanal

Q45. The product (X) is:



- (a) $\text{R}-\text{CH}=\text{CH}-\text{CH}=\underset{\text{NH}_2}{\underset{|}{\text{CH}}}-\text{NH}-\text{NH}_2$
 (b) $\text{R}-\text{CH}=\text{CH}-\text{CH}=\text{N}-\overset{\text{O}}{\underset{\text{NH}_2}{\underset{|}{\text{C}}}}-\text{NH}-\text{NH}_2$
 (c) $\text{R}-\text{CH}_2-\overset{\text{O}}{\underset{\text{NH}_2}{\underset{|}{\text{C}}}}-\text{CH}=\text{N}-\text{NH}-\overset{\text{O}}{\underset{\text{NH}_2}{\underset{|}{\text{C}}}}-\text{NH}_2$
 (d) $\text{R}-\text{CH}=\text{CH}-\text{CH}=\text{N}-\text{NH}-\overset{\text{O}}{\underset{\text{NH}_2}{\underset{|}{\text{C}}}}-\text{NH}_2$

Directions (Q46 to Q50) Answer the question on basis of passage given below:

Nitrogen differs from the rest of the members of its group due to its small size, high electronegativity, high ionisation enthalpy and non-availability of d-orbitals. Nitrogen has unique ability to form $p\pi-p\pi$ multiple bonds with itself and with other elements having small size and high

electronegativity (eg. C, O) Heavier elements of this group do not form $p\pi-p\pi$ bonds as their atomic orbitals are so large and diffused that they cannot have effective overlapping.

Q46. Single bond is **not** formed by two atoms of:

- (a) P - P
 (b) N - N
 (c) As - As
 (d) Sb - Sb

Q47. Maximum covalency of Nitrogen is:

- (a) 2
 (b) 3
 (c) 4
 (d) 5

Q48. Nitrogen family show reducing characters. Least basic amongst the following is:

- (A) SbH_3
 (B) BiH_3
 (C) NH_3
 (D) PH_3

Choose the **correct** answer from the options given below:

- (a) (C) Only
 (b) (A) Only
 (c) (B) Only
 (d) (D) Only

Q49. Most stable hydride amongst the following is:

- (A) NH_3
 (B) PH_3
 (C) AsH_3
 (D) SbH_3
 (E) BiH_3

Choose the **correct** answer from the options given below:

- (a) (A) Only
 (b) (B) Only
 (c) (C) & (D) Only
 (d) (D) & (E) Only

Q50. Nitrogen family show reducing characters. Least basic amongst the following is:

- (a) SbH_3
 (b) BiH_3
 (c) NH_3
 (d) PH_3

SOLUTIONS

S1. Ans. (b)

- Sol.** A. Tetracarbonylnickel (0) - $\text{Ni}(\text{CO})_4$
 B. Tetraammineaquachloridocobalt (III) chloride - $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$
 C. Potassium tetrahydroxidozincate (II) - $\text{K}_2[\text{Zn}(\text{OH})_4]$
 D. Dichloridobis (ethane-1,2-diamine)cobalt(III) - $[\text{CoCl}_2(\text{en})_2]^+$

S2. Ans. (b)

- Sol.** A. Cheese is a gel (type of colloid). In it, the dispersed phase is liquid (water) and dispersion medium is solid (fats).
 B. In a sol, solid particles are put in a continuous liquid to make the colloid. The dispersing medium is liquid and the dispersed phase is solid. Cell fluid contains many solid particles which are in a colloidal range flowing through it. So cell fluid is a **sol**.
 C. In hair cream, both the dispersion medium and dispersed phase are liquids, hence it is an example of emulsion.
 D. When the liquid particles are suspended in a gaseous medium, the nature of the colloid is a liquid aerosol. Hence clouds are aerosols.

S3. Ans. (b)

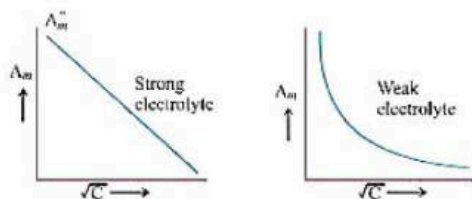
Sol.

Seven crystal systems and its lattice Parameters

Sr. No.	Crystal System	Axial length of Unit Cell	Inter axial angles	Number of Lattice in the system
1	Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90^\circ$	3
2	Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90^\circ$	2
3	Orthorhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90^\circ$	4
4	Monoclinic	$a \neq b \neq c$	$\alpha = \beta = 90^\circ \neq \gamma$	2
5	Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90^\circ$	1
6	Trigonal	$a = b = c$	$\alpha = \beta = \gamma < 120^\circ, \neq 90^\circ$	1
7	Hexagonal	$a = b \neq c$	$\alpha = \beta = 90^\circ, \text{ and } \gamma = 120^\circ$	1

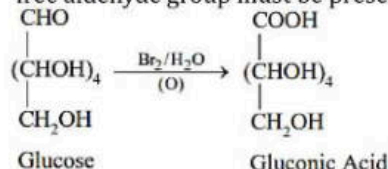
S4. Ans. (b)

- Sol.** A. Molar conductance of KCl increase slowly with the decrease in concentration because of the weakening of inter-ionic attractions and increase in ionic mobilities.
 B. Conductivity is directly proportional to the number of ions present per unit volume of the solution. When we dilute the acetic acid solution, its degree of dissociation increases

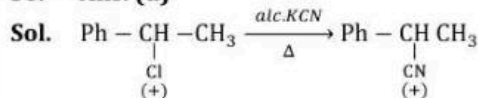


S5. Ans. (b)

- Sol.** Glucose on oxidation with bromine water yields gluconic acid. This reaction confirms presence of aldehyde group because for formation of gluconic acid free aldehyde group must be present.



S6. Ans. (d)



S7. Ans. (a)

- Sol.** Adrenaline is a natural hormone that is produced by the body and secreted throughout the body and helps in regulation of sympathetic and parasympathetic response. It causes an increase in blood pressure, increased breathing, boosting up of energy, etc. This hormone is also called as fight and flight hormone.

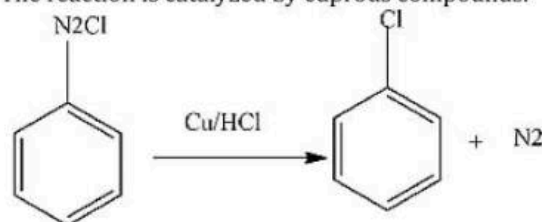
S8. Ans. (b)

- Sol.** Suppose, the number of Fe^{3+} ions in one formula unit of $\text{Fe}_{1.9}\text{O}_3 = x$
 So, number of Fe^{4+} ions per formula unit = $(1.9 - x)$.
 The number of O atoms per formula unit of $\text{Fe}_{1.9}\text{O}_3 = 3$
 In one formula unit of $\text{Fe}_{1.9}\text{O}_3$, total charge of cations = $3x + 4(1.9 - x)$ and total charge of anions = $-2 \times 3 = -6$
 Since crystal of $\text{Fe}_{1.9}\text{O}_3$ is electrically neutral, the sum total positive charge and total negative charge is equal to zero.
 $3x + 4(1.9 - x) - 6 = 0$ or $x = 1.6$
 Hence, in the crystal of $\text{Fe}_{1.9}\text{O}_3$, the percentage of Fe^{3+} ions = $1.6/1.9 \times 100 = 84.21\%$
 and the percentage of Fe^{4+} ions = $(1.9 - 1.6)/1.9 \times 100 = 15.79\%$

S9. Ans. (b)

Sol. Sandmeyer reaction:

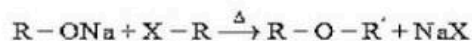
It converts aryl diazonium salts to aryl halides. An aromatic amino group is substituted with a nucleophile (such as halide anions, cyanide, thiols, water, and others) via diazonium salt intermediate. The reaction is catalyzed by cuprous compounds.



S10. Ans. (a)

Sol. A. Williamson synthesis:

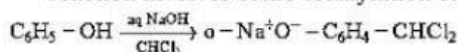
It is used for the preparation of simple as well as mixed ethers. Alkyl halide is heated with alcoholic sodium or potassium alkoxide to form corresponding ethers.



Thus, methyl iodide, on heating with alcoholic sodium methoxide forms dimethyl ether.

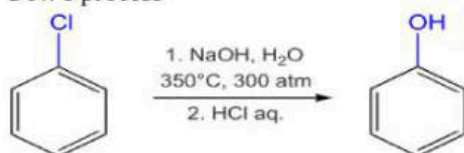
B. Reimer-Tiemann reaction:

Phenol is converted to salicylaldehyde (ortho hydroxy benzaldehyde) by treatment with NaOH/chloroform. Thus Reimer-Tiemann reaction involves ortho-formylation of phenols.

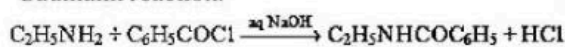


Major product is ortho isomer which is separated from para isomer by steam distillation. Ortho isomer predominates due to its stability due to intramolecular hydrogen bonding.

C. Dow's process



D. The following reaction is called Schotten Baumann reaction.



Schotten Baumann reaction is benzoylation of compounds containing an active hydrogen such as alcohols, phenols or amines with benzoyl chloride in the presence of dilute aq NaOH solution.

S11. Ans. (d)

Sol. Range of particle size for colloidal solution is 1 nm – 1000 nm.

CMC $\Rightarrow 10^{-4}$ to 10^{-3}
Min. Max.

S12. Ans. (d)

Sol. Cu^+ ion has a $3d^{10}$ electronic configuration. It has a fully filled stable d^{10} configuration, thus it requires high energy to remove an electron from the fully filled d orbital. Therefore, Cu has the highest second ionization enthalpy.

B. Zn^{2+} has a $3d^{10}$ electronic configuration. Zn^{2+} ion is highly stable due to the fully filled d^{10} configuration and thus it requires high energy to remove an electron from the fully filled d orbital. Therefore, Zn has the highest third ionization energy.

C. The M in $M(CO)_6$ is Chromium. A stable complex is formed when its EAN (Effective atomic number) is equal to the atomic number of the nearest noble gas. The nearest noble gas is Kr having atomic number 36

EAN = Total electrons of metal + number of electrons given by ligand

Each CO ligand contributes two electrons.

$$36 = x + 2(6)$$

$$(x) = 36 - 12 = 24$$

24 is the atomic number of chromium.

D. Co is having highest number of unpaired electrons & therefore Co is having highest heat of atomization.

S13. Ans. (d)

Sol. Order of Acidity– o-nitrophenol > m-nitrophenol > phenol > o-cresol > ethanol

o-nitrophenol is more acidic than phenol due to electron withdrawing nature of nitro group. o-cresol is less acidic than alcohol due to the electron-releasing nature of methyl group.

3-nitrophenol or m-nitrophenol is more acidic than phenol due to electron attracting nature of NO_2 group. As we all know NO_2 has both -I and -M effect, so after removal of H^+ conjugate base will be formed and if it is stabilized it will make easier deprotonation.

S14. Ans. (c)

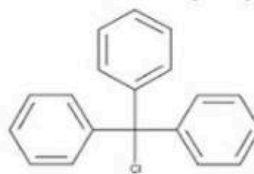
Sol. [Hint]: $p^0_1 - p_1 / p^0_1 = i(n_2/n_1)$
 $(900-200)/900 = i(1/2) = 1.56$

S15. Ans. (a)

- Sol.**
- Blood thus becomes negatively charged due to presence of negatively charged heparin in it. Thus, blood is a negatively charged.
 - Congo red is an acidic stain which is negative in charge.
 - Silver sol, As_2S_3 sol, starch sol, silicic acid sol, congo red dye, gum, clay and charcoal are negatively charged sols.
 - Gold sol being a sol of gold (Au) metal is thus, a lyophobic. Metal sols are generally negatively charged. Therefore, gold sol is also a negative charged.
 - $Fe(OH)_3$ sol contains positively charged colloidal particles.

S16. Ans. (a)

Sol. 1-Chloro-1, 1, 1-triphenylmethane is a tertiary halide.



Tertiary Halide undergoes S_N1 faster than secondary and Primary Halide because Carbocation formed in Tertiary Halide is more stable in case of Carbocation formed in Primary Halide.

S17. Ans. (b)

Sol. The magnetic nature of elements depends on the presence of unpaired electrons. $3d^5$ configuration of transition elements which shows highest magnetic moment as it has maximum number of unpaired electrons (5 unpaired electrons).

S18. Ans. (c)

Sol. The reactants are continuously supplied from external source. Hence fuel cells run till reactants are active.

S19. Ans. (a)

Sol. A. Tollens' test, also known as a silver-mirror test, is a qualitative laboratory test that is used to differentiate between an aldehyde and a ketone. It uses the fact that aldehydes can be more easily oxidized than ketones. This test cannot distinguish between an aldehyde and an α -hydroxy ketone (e.g., hydroxy acetone) [1-4]. During the process, two events occur. First, the aldehyde gets converted into carboxylic acid. Second, the Ag^+ ions are reduced to Ag metal, which leaves a shiny appearance inside the test tube, indicating a positive result.

B. Benzene diazonium chloride on reaction with phenol in a basic medium gives p-Hydroxy azobenzene. This is an example of the coupling reaction.

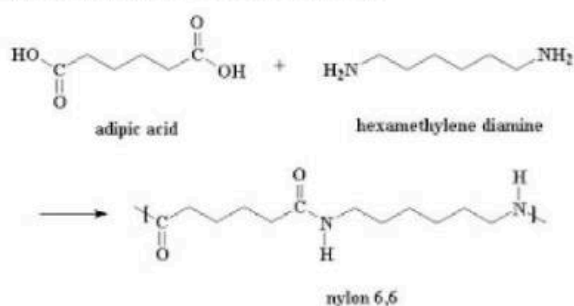
In this type of aromatic electrophilic substitution, the aryldiazonium cation acts as the electrophile whereas the activated arene behaves as a nucleophile; and the resulting diazonium compound is also aromatic in most cases.

C. This is an example of Nucleophilic substitution reaction.



S20. Ans. (d)

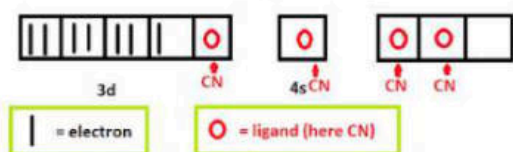
Sol. Nylon 6,6 is obtained by condensation polymerisation of adipic acid and hexamethylenediamine, Nylon 6, 6 is used in making sheets, bristles for brushes and in the textile industry.



S21. Ans.(c)

Sol. A. $[\text{CoF}_6]^{3-}$ is an outer complex having sp^3d^2 hybridization because the complex ion contains weak field ligand so electrons are not paired up and will contain 4 unpaired electrons. Hence the compound is said to be paramagnetic.

B. $[\text{Co}(\text{CN})_4]^{2-}$: oxidation state of Co is +2
 $\text{Co}^{2+} - 1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$



C. $[\text{FeCl}_4]^-$ is sp^3 hybridized and has tetrahedral geometry with 5 unpaired electrons.

D. Hybridization of the compound $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ is d^2sp^3 . As there is no unpaired electron, it is diamagnetic in nature.

S22. Ans. (c)

Sol. A. Copper pyrite is copper iron sulphide with the chemical formula CuFeS_2 .
 B. Malachite $\rightarrow \text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
 C. Cuprite, soft, heavy, red oxide mineral (Cu_2O) that is an important ore of copper
 D. Copper glance is the principal sulfide ore of copper. Its chemical name is Copper(I) sulfide and its chemical formula is Cu_2S .

S23. Ans. (a)

Sol. $[\text{Fe}(\text{CN})_6]^{4-} \rightarrow \text{PO}_4^{3-} \rightarrow \text{SO}_4^{2-} \rightarrow \text{Cl}^-$
 More the valency, more will be flocculating power

S24. Ans. (b)

Sol. A. Roasting is the process of converting an ore into oxide by heating in the presence of air. It is done for sulphide ores.
 $\text{So, PbS} \rightarrow \text{PbO}$ (Roasting)
 B. Calcination is the process in which ore is heated below its melting point in the limited supply of oxygen
 Decomposition of carbonate ore
 $\text{CaCO}_3 \rightarrow \text{CaO}$ (Calcination)
 C. Extraction of zinc: Zinc is extracted through carbon reduction of the ZnS .
 $\text{ZnS} \rightarrow \text{Zn}$ Carbon reduction
 D. $\text{Cu}_2\text{S} \rightarrow \text{Cu}$ (Self reduction)

S25. Ans. (b)

Sol. (i) First order
 (ii) S^{-1}

S26. Ans. (b)

Sol. In this reaction, aniline is diazotized to obtain benzene diazonium chloride (compound A) The diazonium group of benzene diazonium chloride is then replaced with cyano group by Sandmeyer reaction.



S27. Ans. (d)

Sol. Examples of negatively charged sols: Metal sols, metal sulphides, gold sols, blood, starch, acidic dyes, etc.

S28. Ans. (d)

Sol. ethanol - acetone: It is a non-ideal solution and has a positive deviation. It is a minimum boiling azeotrope.

S29. Ans. (c)

Sol. Promethium is a man-made element because it has been prepared by artificial means.

S30. Ans. (a)

Sol. For denaturation of alcohol, methyl alcohol, copper sulphate and pyridine are used.

S31. Ans. (a)

Sol. In the isoelectronic series of metal carbonyl, the CO bond strength is expected to increase in the order $[V(CO)_6]^- < [Cr(CO)_6] < [Mn(CO)_6]^+$. The oxidation state of the central metal atom increases in the order $V(-) < Cr(0) < Mn(+)$. As the oxidation state of the central metal atom increases, less and less electron density is donated to the carbonyl ligand. This increases the CO bond strength as the added electron density occupies the anti-bonding orbital.

S32. Ans. (c)

Sol.

$$\frac{P_1^\circ - P_1}{P_1^\circ} = x_2 = n_2/n_1 + n_2$$

$$\Delta T_b = K_b m = K_b (W_2 \times 1000 / M_2 \times W_1)$$

$$\Delta T_f = K_f m = K_f (W_2 \times 1000 / M_2 \times W_1)$$

$$\pi = CRT = (n_2/V)RT$$

S33. Ans. (b)

Sol. Since the reaction is first order in $CHCl_3$ and $1/2$ order in Cl_2 , the rate law for the reaction will be, Rate = $k[CHCl_3] \times [Cl_2]^{1/2}$. The overall order (n) of the reaction will be, $n = 1 + 1/2 = 3/2$.

S34. Ans. (d)

Sol. Initial mass = $M_0 = 100$ g

$$t_{1/2} = 15 \text{ hrs}$$

to calculate, mass of the substance left undecayed after 75 hrs ($M_z = 75$)

we know,

$$M(z) = M_0 e^{-\lambda t}$$

$$M_0/2 = M_0 e^{-\lambda(15)}$$

$$\lambda = 1/15 \ln(2)$$

$$M_{(75)} = M_0 e^{-\lambda(75)}$$

$$M_{(75)} = M_0 e^{-1/15 \ln(2) \cdot 75}$$

$$M_{(75)} = M_0 e^{-5 \ln(2)}$$

$$M_{(75)} = 100/32 = 3.125 \text{ g}$$

S35. Ans. (d)

Sol. $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

$$E_{\text{cell}} = E^0_{\text{cell}} - 0.059/2 \log [Zn^{2+}]/[Cu^{2+}]$$

When the cell is completely discharge, $E_{\text{cell}} = 0$

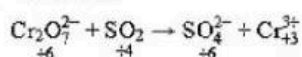
$$0 = 1.1 - 0.059/2 \log [Zn^{2+}]/[Cu^{2+}]$$

$$\text{Or } \log [Zn^{2+}]/[Cu^{2+}] = 2 \times 1.1/0.059 \text{ or } \log Zn^{2+}/Cu^{2+} = 37.3$$

$$\text{Or } Zn^{2+}/Cu^{2+} = 10^{37.3}$$

S36. Ans. (b)

Sol. Reaction:



S37. Ans. (b)

Sol. A. Adenine is a purine, one of the two families of nitrogenous bases.
B. Thymine is one of the pyrimidine bases found in the nucleic acid of deoxyribonucleic acid (DNA),

along with adenine, guanine, and cytosine (A, G, and C, respectively).

C. Uracil (U) is one of the four nucleotide bases in RNA

D. deoxyribose, also called d-2-deoxyribose, five-carbon sugar component of DNA (q.v.; deoxyribonucleic acid), where it alternates with phosphate groups to form the "backbone" of the DNA polymer and binds to nitrogenous bases.

S38. Ans. (a)

Sol. A. Phenelzine is an antidepressant (monoamine oxidase inhibitor).

B. Terfenadine, a bioprecursor prodrug, is an antihistamine used for the treatment of allergic conditions.

C. Codeine is used to relieve mild to moderate pain. It belongs to the group of medicines called narcotic analgesics (pain medicines).

D. Antibiotics are drugs obtained from living matter (microorganism). These are used to kill or prevent the growth of other micro-organism. Antibiotics are very specific in their action. Examples of antibiotics include salvarsan, azodye, prontosil, sulphapyridine etc.

S39. Ans. (c)

Sol. The steric hindrance to the nucleophile in the S_N2 mechanism increases with a decrease in the distance of the substituents from the atom containing the leaving group. Further, the steric hindrance increases with an increase in the number of substituents. Therefore, the increasing order of steric hindrances in the given compounds is as below:

1-Bromobutane < 1-Bromo-3-methylbutane < 1-Bromo-2-methylbutane < 1-Bromo-2, 2-dimethylpropane

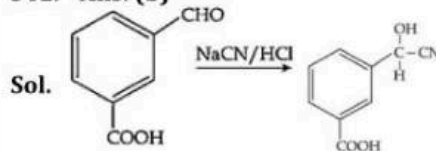
Hence, the increasing order of reactivity of the given compounds towards S_N2 displacement is:

1-Bromo-2, 2-dimethylpropane < 1-Bromo-2-methylbutane < 1-Bromo-3-methylbutane < 1-Bromobutane

S40. Ans. (c)

Sol. Thus, p-nitrophenol has maximum acidic strength and p-cresol has least acidic strength. The order is shown below. p-nitrophenol > phenol > p-cresol.

S41. Ans. (b)

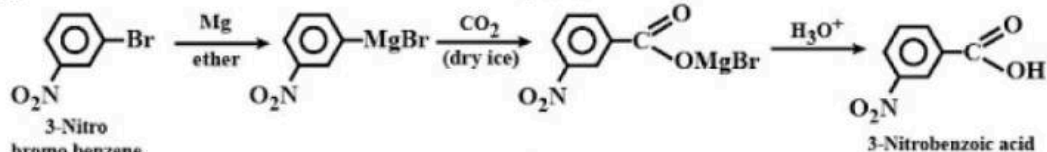


S42. Ans. (c)

Sol. $-NO_2$ is more electronegative than fluorine. Thus NO_2CH_2COOH would be most acidic, followed by FCH_2COOH and C_6H_5COOH .

Higher the stability of conjugate base, higher is the acidity. Hence, C_6H_5COOH is more acidic than $C_6H_5CH_2COOH$.

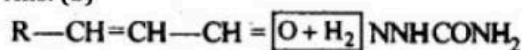
S43. Ans. (a)



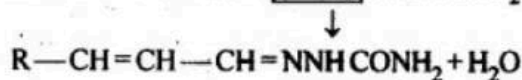
S44. Ans. (c)

Sol. The +I effect of the alkyl group increases in the order: Ethanal < Propanal < Propanone < Butanone. The electron density at the carbonyl carbon increases with the increase in the +I effect. As a result, the chances of attack by a nucleophile decrease. Hence, the increasing order of the reactivities of the given carbonyl compounds in nucleophilic addition reactions is: Butanone < Propanone < Propanal < Ethanal.

S45. Ans. (b)



Sol.



S46. Ans. (b)

Sol. The chemistry of nitrogen is dominated by the ease with which nitrogen atoms form double and triple bonds. A neutral nitrogen atom contains five valence electrons: $2s^2 2p^3$. A nitrogen atom can therefore

achieve an octet of valence electrons by sharing three pairs of electrons with another nitrogen atom.

S47. Ans. (c)

Sol. Covalency of an atom in a covalent compound is the number of covalent bonds formed by an atom. Maximum covalency of Nitrogen is 4 (example - ammonium ions).

S48. Ans. (c)

Sol. BiH_3 is the least base because the size of a central atom of BiH_3 is much larger than nitrogen which decreases its basicity.

S49. Ans. (a)

Sol. NH_3 is the most stable hydride among the hydrides of group 15 elements because the strength of E-H (Here E = N, P, As, Sb, or Br) bond decreases down the group due to increase in size of the central atom.

S50. Ans. (b)

Sol. BiH_3 is the least base because the size of a central atom of BiH_3 is much larger than nitrogen which decreases its basicity.